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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. |
|---|---|---|---|
| 09/329,156 | 06/09/99 | QU Z | IR-1677 |

002352 MMC1/0620
OSTROLENK FABER GERB & SOFFEN
1180 AVENUE OF THE AMERICAS
NEW YORK NY 10036-8403

| EXAMINER | |
|---|---|
| HU,S | |
| ART UNIT | PAPER NUMBER |
| 2811 | |

DATE MAILED: 06/20/01

**Please find below and/or attached an Office communication concerning this application or proceeding.**

**Commissioner of Patents and Trademarks**

# Office Action Summary

| Application No. | Applicant(s) |
|---|---|
| 09/329,156 | Qu et al. |
| **Examiner** | **Art Unit** |
| Shouxiang Hu | 2811 |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *three* MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1) ☒ Responsive to communication(s) filed on *Apr 2, 2001*

2a) ☒ This action is **FINAL.** 2b) ☐ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

**Disposition of Claims**

4) ☒ Claim(s) *1-9* is/are pending in the applica

4a) Of the above, claim(s) _____ is/are withdrawn from considera

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) *1-9* is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claims _____ are subject to restriction and/or election requirem

**Application Papers**

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.

12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. § 119**

13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

a) ☐ All b) ☐ Some* c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

**Attachment(s)**

15) ☒ Notice of References Cited (PTO-892)

16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____

18) ☐ Interview Summary (PTO-413) Paper No(s). _____

19) ☐ Notice of Informal Patent Application (PTO-152)

20) ☐ Other:

## DETAILED ACTION

### *Claim Cancellation*

1. Claims 10-12 are canceled according to Applicant's amendment filed on 4/02/01.

### *Claim Rejections - 35 USC § 102*

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1 and 2 are rejected under 35 U.S.C. 102(b) as being anticipated by Roger ("Roger"; 4,258,380).

Roger discloses a semiconductor device (Fig. 2, and see col. 4, lines 10-12), comprising: a silicon substrate (10 and 11); a first layer (12a); a second layer (12b); and a plurality of opposite type diffusion regions (13a and 13b), wherein, within each of the first and second layers, the impurity distribution and thereby the resistivity are uniform, as the doping is carried out during the epitaxial growth of those silicon layers, and the impurity concentration is higher in the second layer than in the first layer, which inherently results in a lower resistivity in the second layer compared with the one in the first layer.

***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 1-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Merrill et al. ("Merrill"; 5,661,314).

Merrill discloses a semiconductor device (Figs. 4 and 20), comprising: a silicon substrate (51); a first epitaxial silicon layer (52); a second epitaxial silicon layer (180); and a plurality of opposite type diffusion regions (81), wherein the first layer (52) is thicker than the second layer (180) (see col. 9, lines 13-27, and col. 14, lines 55-65); doping in the first layer is carried out during its epitaxial growth (see Fig. 4, and col. 9, lines 13 and 14), which inherently results in an uniform impurity distribution in the first layer; and, the impurity concentration is higher in the second layer than in the first layer, which inherently results in a lower resistivity in the second layer compared with the one in the first layer.

Although Merrill does not disclose that the doping in the second layer can also be carried out during its epitaxial growth, it is noted that it is well known in the art that doping can be carried out during the epitaxial growth, as evidenced in Merrill (Fig. 4, and col. 9, lines 13 and 14) and in Roger (Fig. 2, and col. 4, lines 10-12); and that, by doing so, the usually lengthy doping process through diffusion can be eliminated.

Therefore, it would have been obvious to one of ordinary skilled in the art at the time the invention was made to make the semiconductor device of Merrill with the doping in the second layer being carried out during its epitaxial growth, so that the doping process would be simplified. And, by doing so, the impurity distribution and thereby the resistivity in the second layer would be inherently uniform.

Regarding claim 9, Merrill et al. Further disclose that the invention can also be applied to MOSFET (see col. 1, lines 10-25)

6. Claims 1-9 are further rejected under 35 U.S.C. 103(a) as being unpatentable over Muramoto ("Muramoto"; 4,884,113).

Muramoto discloses (Fig. 3) a semiconductor device comprising: A semiconductor substrate (10a); a first layer (10b; $N^-$-type and uniformly doped); a second layer (the horizontal portion of 12; $N^+$-type and uniformly doped, see Fig. 5A); a plurality of P-type layer (11) on the surface of the second layer and defining p-n junctions therein.

Although Muramoto does not explicitly disclose that the semiconductor substrate is a silicon substrate, it is noted that silicon substrate is the most commonly used semiconductor substrate. Therefore, ordinary skilled in the art would readily recognize that a silicon substrate can be used as the semiconductor substrate to form Muramoto's semiconductor device.

In addition, although Muramoto does not explicitly disclose which process is used to form the first and second layers, it is noted that it is old and well known in the art that epitaxial

deposition is one of the most widely used processes to form semiconductor layers. Besides, the process limitations of "epitaxially deposited" or "separately deposited" recited in claims 1-12 would not carry patentable weight in these claims drawing to a structure, because distinct structure is not necessarily produced. In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985).

Regarding claim 2, the second layer (12) has a resistivity inherently lower than the one in the $N^-$-type first deposited layer (10b), as doping concentration in the second layer is higher.

Regarding claims 3-4, the first layer is thicker than the second layer in Muramoto.

Regarding claims 5-8, Muramoto discloses that higher reverse bias voltage can be obtained with the bi-layer structure. Therefore, Muramoto's device is inherently capable of having the total thickness of the first and second layers thinner than the thickness of a single layer designed to block a same voltage.

Regarding claim 9, Muramoto's device is a vertical DMOS, which is one of the various types of MOSFET and can be used in conduction power applications. The thickness of the bottom portion (10b) is more than 50% of the total thickness of the upper portion (12) and the bottom portion.

***Response to Arguments***

7. Applicant's arguments filed on 4/02/2001 have been fully considered but they are not persuasive.

With respect to Applicant's argument that Merrill does not show or suggest a uniform distribution of dopants in the second layer, as noted in the obviousness rejection based on Merrill above, one of ordinary skilled in the art would readily recognize that the doping in the second layer of Merrill can be carried out during its epitaxial growth for simplifying the doping process. And, the impurity distribution and thereby the resistivity in the second layer would be inherently uniform as dopants are normally uniformly distributed in the epitaxial source phase when the doping is carried out during the epitaxial growth.

***Conclusion***

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

9. Papers related to this application may be submitted to Technology center (TC) 2800 by facsimile transmission. Papers should be faxed to TC 2800 via the TC 2800 Fax center located in Crystal Plaza 4, room 4-C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (November 15, 1989). The Group 2811 Fax Center number is (703) 308-7722 or 308-7724. The Group 2811 Fax Center is to be used only for papers related to Group 2811 applications.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ***Shouxiang Hu*** whose telephone number is **(703) 306-5729**. The examiner can normally be reached on Tuesday through Friday from 7:30 AM to 5:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, ***Tom Thomas***, can be reached on **(703) 308-2772**. The appropriate fax phone number for the organization where this application or proceeding is assigned is **(703) 308-7724**.

Any inquiry of a general nature or relating to the status of this application should be directed to the **Technology Center Receptionists** whose telephone number is **(703) 308-0956**.

Shouxiang Hu
June 13, 2001

Tom Thomas

**TOM THOMAS**
**SUPERVISORY PATENT EXAMINER**